MODEL TTS 26A
PULSE SIGNALING TEST SET

GENERAL ELECTRIC CO.
LOS ANGELES INSTRUMENTATION
11223 SOUTH HINDRY AVE.
LOS ANGELES, CA 90045

NORTHEAST ELECTRONICS CORPORATION
P. O. Box 649 - Concord, N.H. 03301

NORTHEAST ELECTRONICS CORPORATION

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MODEL TTS 26A PULSE SIGNALING TEST SET

OPERATING INSTRUCTIONS

1.0 GENERAL

1.01 The Model TTS 26A is a compact, transistorized, pulse signaling test set designed to send pulses, generated by either a built-in oscillator or by an external source, and to measure the % break of the transmitted pulses or of pulses received from external circuits. The % break of the pulses transmitted by the instrument can be varied over a wide range.

1.02 Signals can be received or transmitted on a LOOP or E&M basis. Connection with the circuits to be tested is made through a series of jacks. Several switches permit the operator to set up the different circuits required for measurements on LOOP, E&M circuits, etc. The simplified schematics of the circuits provided in the set are shown in Fig. 1.

1.03 A single scale meter calibrated in 1% divisions is used to measure % break. The single scale is made possible by switching the meter circuit to correspond to the selected mode of operation. This minimizes the possibility of making errors in reading the meter.

1.04 The Model TTS 26A may be operated in any position.

1.05 Normally the instrument is operated from the 48-volt central office battery. In emergencies a heavy duty 45-volt dry battery can be used for a period of time.

1.06 The set is contained in a metal box with a removable hinged lid which includes a storage compartment for cords, small tools, and other items. A chart of schematic diagrams showing the SEND and RECEIVE circuits connected for different modes of operation is printed on the storage compartment cover. This permits a quick check on the test circuits being used.

2.0 PERFORMANCE AND SPECIFICATIONS

2.01 % Break Meter

A $4\frac{1}{2}$" meter with a single scale calibrated from 0 to 100% in 1% divisions. Damping circuits permit proper reading of the standard % break when the digit 0 is dialed on a 10 cps dial; they also reduce pointer vibration to about ± 1 division on 10 pps signals.

2.02 Impedance of Measuring Circuit

Approximately 7500 ohms.

2.03 Send Signals

6, 8, 10, 12, 14, 20 Pulses/Sec. Additional frequencies can be installed on special order.

2.04 Send % Break Range

At least 12% to 85% for OSCILLATOR drive. Approximately the same limits apply when using a dial as a source of pulses.

2.05 Calibration

An adjustable calibration permits operation of the set on battery voltages from approximately 35 to 55 volts. The set can be operated to receive and to send with an external dial on a 24-volt supply. Operation with the internal oscillator requires a battery voltage of at least 35 volts. If 24-volt operation of the oscillator is desired, rearrangement of circuit constants is required.

2.06 Power Requirements

48 volts DC, 120 ma. A diode protects the internal circuits against damage in the event the battery polarity is reversed.

2.07 Size and Weight

The case and cover are 11"w x 9" h x 8" d and weigh 13 pounds.

3.0 CONTROLS AND JACKS

1. ADJUST % BREAK Control

   Provides means for setting the % break on the transmitted pulses from the oscillator or the external dial.

2. METER CALIBRATION Control

   Provides full scale calibrating of the meter for different supply voltages.

3. PULSES PER SEC Switch

   Provides the following functions:

   a. Switches the power ON or OFF.
   b. Switches the pulse rate of the internal oscillator.
   c. Switches the external dial circuit to 24 volts.

4. FUNCTION Switch

Provides the following functions:

a. ON HOOK
b. OFF HOOK
c. SEND & REC
d. ADJ % BREAK
e. CAL METER

5. OPERATION Switch

Provides the following mode of operation:

a. REC B&G, SEND LOOP
b. REC LOOP, SEND LOOP or SL
c. B&G TWD LINE
d. B&G TWD DROP
e. B&O TWD LINE
f. B&O TWD DROP

6. SEND RT/SL Turnbutton Switch

Provides selection between sending on RT or on the sleeves of SEND LOOP 1 and 2 jacks when OPERATION switch is in second position (see paragraph 5 above)

7. SEND and TEST Key Switch

a. TEST L&D
b. DIAL or TALK (depending on position of DIAL and TALK switch)
c. OSCILLATOR

8. DIAL and TALK Key Switch

a. TALK E&M (on RT of SEND LOOP 1 and 2)
b. DIAL
c. TALK LOOP (on RT of SEND LOOP 1 and 2)

9. SPARK SUPPRESSOR Turnbutton Switch

Inserts or removes the internal spark suppressor on the SEND contacts.

3.02 The following jacks and terminals are provided:

1. Two binding posts for DIAL or TEL SET
2. Jack for DIAL or TEL SET
3. Jack for SEND LOOP 1
4. Jack for SEND LOOP 2
5. Jack for REC LOOP
6. Jack for E lead
7. Jack for M lead
8. Jack for LINE
9. Jack for DROP
10. Jack for 48 volts DC (BATT. NEG. ON TIP)
11. Jack for 48 volts DC (BATT. NEG. ON SLEEVE)

The E and M leads are connected to the tip and ring terminals, respectively, of the LINE jack.

All jacks are for Type 310 plugs.

The two jacks for the LINE and DROP and those for the E&M functions are spaced to accommodate a Type 241 Plug.

4.0 CIRCUIT DESCRIPTION

Schematic Diagram

4.01 The schematic diagram of the instrument is shown in Fig. 2. The circuits can be divided into two sections -- the receive or measuring section and the pulse SEND section. A detailed description of each section is presented below.

Receive and Measuring Section

4.02 The measuring section of the Model TTS 26A provides the means for measuring the % break of pulses received from loop or E&M circuits. Extra sections on the FUNCTION and OPERATION switches change the meter circuits automatically to permit the use of a single scale meter.

4.03 The measuring circuit includes a $4\frac{1}{2}$" meter with a 1 ma movement. A single scale calibrated from 0 to 100% in 1% divisions is used to facilitate reading % break. The R-C time constants of the meter circuit have been designed to permit proper reading of the break when the digit 0 is dialed on an external dial. This damping is also sufficient to keep the angular vibration of the meter pointer to within approximately ± 1 division on the meter scale when a pulse rate of 10 pps is measured.

4.04 A calibration control in series with the meter permits setting an accurate full scale reading (i.e., 100% break) for the battery voltage from 42 to 55 volts.

4.05 When a relay pulses battery and ground, the transit time of the relay becomes a factor in measuring the % break of the received or transmitted pulses. A compensation circuit including a variable resistor, is provided to give an accurate meter reading under these conditions. The variable resistance is ganged to the meter calibration control so that it is automatically set to the proper value when the meter is calibrated for full scale, i.e., 0% break. It will be noted that the meter reads approximately 50% break when the set is not connected to a circuit and the OPERATION switch is set at B&G TWD DROP and the FUNCTION switch is in the SEND & REC position.

4.06 The impedance of the measuring circuit is approximately 7500 ohms, which is high enough to permit bridging measurements on many circuits.

Pulse SEND Section

4.07 The signals to operate the SEND relay can be derived from a built-in transistorized oscillator or from an external dial connected to the DIAL or TEL SET jack or terminals. When the internal oscillator is used, a sine wave signal is supplied to one winding of the DRIVE relay. When the external dial circuit is used, signals having a wave shape approximating the sine wave are supplied to this same winding. The other winding of this relay is connected to a DC circuit in which positive or negative bias can be applied under the control of the % BREAK potentiometer. The DC bias shifts the operating point of the DRIVE relay and causes it to transmit pulses which are lengthened or shortened as compared to those transmitted in the absence of any bias.

4.08 In the biasing circuit described above, the effective drive power of the relay becomes unsymmetrical and appreciable amounts of armature transfer time can occur. Thus it is not desirable to derive the SEND signals directly from the DRIVE relay. For this reason the contacts of the DRIVE relay are used to drive a second relay, the SEND relay. This second relay obtains full excitation whenever the DRIVE relay operates. As a result of the bistable characteristics of the SEND relay, assisted by the spark suppressors on the DRIVE relay contacts, the transfer time of the SEND relay is kept low under all conditions. In order to permit use of the TTS 26A for switching of voice frequency circuits, the spark suppressors can be omitted from the contacts of the SEND relay with the SPARK SUPPRESSOR turnbutton switch. If the TTS 26A is to be used on high power or highly inductive circuits, the internal spark suppressor circuit should be used. Access to the armature, make, and break contacts of the SEND relay is obtained on the tip, ring, and sleeve of the SEND LOOP 1 jack when the OPERATION switch is in the first or second position.

CAUTION: If the TTS 26A SEND circuits will be switching currents of more than 100 ma, voltages in excess of 50 volts or inductive circuits, the internal spark suppressor should be switched O

This internal circuit, when switched ON, protects the SEND relay contacts with arc reduction networks of 0.1 mfd and 220 ohms. These values are generally satisfactory for standard 48-relay switching circuits.

Earlier models (below Serial No. 400) have not been provided with this spark suppressor circuitry, therefore, external spark suppressors should be added when used on circuits where heavy arcing might be anticipated.

Care must be used when spark suppression is added that the performance of the circuits under test is not affected by the spark suppression circuit.

4.09 The internal oscillator is a conventional transistorized sine wave oscillator equipped with a buffer amplifier to provide the desired signal level to operate the DRIVE relay. When the external dial is used to control the SEND relay, the operation of the dial causes the DIAL relay to operate. The armature of this relay applies battery or ground to a low pass filter. The output of the low pass filter has the sloping waveform which is necessary to obtain proper bias control in the DRIVE relay. To obtain a maximum range of control the filter condenser in the low pass filter should be switched to correspond to the dial speed. This is automatically done by turning the PULSES PER SEC control to the position corresponding to the speed of the dial used.

Simultaneous SEND and MEASURE Operation

4.10 When the FUNCTION switch in the TTS 26A is in the SEND & REC position, the set can simultaneously send signals on one circuit and measure the signals received on another circuit. When the OPERATION switch is in one of the two LOOP positions, the SEND LOOP and REC LOOP jacks are used for this purpose. When the OPERATION switch is in one of the two DROP positions, the TTS 26A will send on the E lead and receive on the M lead.

4.11 For any position of the OPERATION switch, the FUNCTION switch may be turned to the ADJ % BREAK position to check the signals generated by the SEND section of the set. While the FUNCTION switch is in this position the SEND circuits are automatically switched to the OFF HOOK position to prevent losing the circuit under test.

4.12 When the FUNCTION switch is moved from the CAL METER or ADJ % BREAK condition to the SEND & REC position, the meter is transferred to an external receive circuit. As the resistance of this external circuit may vary from circuit to circuit, the meter may or may not read 0% break in the OFF HOOK condition of the external circuit; if it does not, recalibration must be performed as outlined in paragraphs 4 and 8 of section 5.02.

Line and Drop Busy Test

4.13 When the TTS 26A is to be used on E&M supervision circuits, it is desirable to check that the circuit is in the IDLE condition before applying any test signals to it. When the SEND and TEST key is in the TEST L&D position, the E&M circuits are connected straight through and bridging lamp supervision circuits are provided on the E&M leads. When both lamps are lighted, the circuit is idle and the SEND and TEST key may then be moved to either the DIAL or the OSC position to initiate tests. When the OPERATION switch is in the LINE position, moving the SEND and TEST key to the DIAL or OSC position will provide an OFF HOOK condition toward the drop. When the OPERATION switch is in the DROP position, an OFF HOOK condition will similarly be presented to the LINE side.

TALK Circuit

4.14 The TALK circuits are under the control of the DIAL and TALK switch; this switch is in the DIAL position when the TTS 26A is used to measure pulse transmission. When the set is used on a LOOP circuit, the telephone set which is connected to the DIAL or TEL SET jack or terminals can be extended straight through to the ring and tip of the SEND LOOP 1 or 2 jack by moving the switch to the TALK LOOP position. The telephone set will then receive its talk battery from the loop circuit connected to the SEND LOOP jack.

4.15 When the TTS 26A is used on circuits with E&M supervision, talk battery is generally not available on the ring and tip terminals of the associated voice circuit jacks. To provide talking facilities on such circuits, the DIAL and TALK switch is moved to the TALK E&M position. In this position talk battery is supplied to the telephone set from the TTS 26A, simultaneously condensers are inserted between the RT circuits on the DIAL or TEL SET jack and the SEND LOOP jacks.

5.0 CALIBRATION

5.01 The meter circuit of the TTS 26A must be calibrated for the supply voltage used. The instrument will operate satisfactorily and the METER CAL control will calibrate the meter over a range of input voltage extending from 42 volts to 55 volts.

5.02 The following procedure is used for calibrating the meter circuit:

1. Connect the available DC voltage to the proper 48-volt jack as indicated on the front panel.

2. Set the SEND & TEST key to OSC. If a dial is used a. a source of pulses, set this key to DIAL.

3. Set the PULSES PER SEC switch to the desired pulse rate if the oscillator is used as a source of signal. If a dial is to be used as a source of signal, set it to the speed of the dial which is connected to the DIAL jack.

4. Turn the FUNCTION switch to the CAL METER position.

5. Adjust the METER CAL control to set the meter point at 0 (or METER CAL) on the meter scale.

6. Turn the FUNCTION switch to the ADJ % BREAK position.

7. Set the ADJ % BREAK control for the desired % break as indicated on the meter. When a DIAL is used to generate the signal, dial an 0 when setting the desired % break.

8. Turn the FUNCTION switch to the SEND & REC position.

9. With the distant end of the receive circuit in the OFF HOOK condition, observe the % break meter; if it does not indicate 0%, adjust the METER CAL control to bring the needle to the 0 mark. This calibration should be rechecked whenever the position of the OPERATION switch is changed.

   NOTE: In older sets (below Serial No. 190) this recalibration is required when switching to a 0 resistance external E lead; in later sets, recalibration is normally not required in this case.

10. The instrument is now ready for use.

    CAUTION: If, after completing steps 1 through 9, it is desired to recheck the % break, then all steps, starting with step 3, must be repeated.

6.0 OPERATION

Initial Steps

6.01 The following steps should be taken to prepare the set for operation:

1. Unlatch and open cover. The cover can easily be detached by sliding it to the right side of the instrument. If cords or other items stored in the cover are needed, the hinged lid may be opened by first turning the thumbscrew which serves as a latch.

2. First connect a cord to the proper 48-volt jack in the TS 26A.

Thereafter connect the other end of the cord to a 48-volt supply jack. When disconnecting the set, first remove the cord from the supply jack. In the event that battery is reversed, the TTS 26A will not be damaged because an internal protective diode is provided; however, it would not be possible to calibrate or use the instrument.

3. Turn the PULSES PER SECOND switch to the desired dial speed. This also turns the set ON.

4. With reference to the simplifier functional circuit diagram of Fig. 1 (Note: this diagram is also shown on the compartment lid) turn the OPERATION switch to the desired operating mode.

5. Calibrate as outlined under Section 5.0

   NOTE: Calibration should be rechecked when the position of the OPERATION switch is changed.

6. The instrument is now ready for use.

   CAUTION: If the TTS 26A SEND circuits will be switching currents of more than 100 ma, voltages in excess of 50 volts or inductive circuits, the internal spark suppressor circuit should be switched ON. This internal circuit, when switched ON, protects the SEND relay contacts with arc reduction networks of 0.1 mfd and 220 ohms. These values are generally satisfactory for standard 48-relay switching circuits.

   Earlier models (below Serial No. 400) have not been provided with this spark suppressor circuitry; therefore external spark suppressors should be added when used on circuits where heavy arcing might be anticipated. Care must be used when spark suppression is added that the performance of the circuits under test is not affected by the spark suppression circuit.

Cover Diagram

6.02 The different circuits which can be set up under the control of the OPERATION switch are shown in condensed form in Fig. 1 and on the the storage compartment lid in the cover of the TTS 26A.

It illustrates in simplified form the circuits connected to the various jacks for different positions of the OPERATION switch when the

FUNCTION switch is in the SEND & REC and ADJ % BREAK positions. The connections established by the DIAL and TALK and the SEND and TEST key switches are also shown. This diagram serves as a quick reference to determine what test circuit connections are being used. This diagram is the same as Fig. 1 in this instruction manual.

Measuring % Break of a Received Signal

6.03 In all measurements described in this paragraph it is important, prior to conducting any receive measurements, to first adjust the METER CAL control for a 0% meter indication with the FUNCTION switch in either the OFF HOOK or the SEND & REC position and the external receive circuit in the OFF HOOK condition. This operation must be performed AFTER the RECEIVE circuit has been established as described below in order to correct for resistance or supply voltage variations of the external receiving circuit.

1. If the % break of a circuit which provides a battery and ground on ring and tip is to be measured, use the REC B&G and SEND LOOP position of the OPERATION switch and connect the line to be tested to the REC LOOP jack. The % break received from the circuit under test is now read on the meter.

2. If the % break of a circuit (for instance, a dial) which provides "open and short" pulses is to be measured, turn the OPERATION switch to the REC LOOP & LOOP SEND or SL position and connect the circuit to be tested to the REC LOOP jack. The % break received from the circuit under test is now read on the meter.

3. If the % break on the LINE side of an E&M circuit is to be measured, turn the OPERATION switch to the B&G TWD LINE or B&O TWD LINE position, as the case required and move the SEND and TEST switch to the TEST L&D position. First insert a twin cord in the LINE and DROP twin jacks on the TTS 26A and then insert the other end in the jack field. If both lamps are lighted, indicating that the circuit is IDLE, move the SEND and TEST switch to the DIAL position. The % break received from the line circuit is now read on the meter.

4. If the % break on the DROP side of an E&M circuit is to be measured, turn the OPERATION switch to the B&G TWD DROP or B&O TWD DROP position, as the case requires, and the SEND and TEST switch to the TEST L&D position. First insert a twin cord in the LINE and DROP twin jacks on the TTS 26A and then insert the other end in the jack field.

If both lamps are lighted, indicating that the circuit is IDLE, move the SEND and TEST switch to the DIAL position. The % break received from the DROP circuit is now read on the meter.

5. If the % break received from the LINE side of an E&M circuit is to be measured in LINE equipment which has separate E and M jacks, turn the OPERATION switch to the B&G TWD LINE or B&O TWD LINE position as the case requires. Move the SEND and TEST switch to the DIAL position, insert a cord in the E jack and connect the other side of this cord to the E jack in the equipment. The % break received from the circuit under test is now read on the meter.

Sending a Predetermined % Break

6.04 Send signals can be derived either from the built-in oscillator or from a dial, from the dial in the telephone set, or from any other interrupter device connected to the DIAL or TEL SET jack or terminals. The position of the SEND and TEST switch determines which of the two signals is used.

CAUTION: 1. If the internal oscillator is used, set the PULSES PER SEC switch to the desired value.

2. If the external dial is used, first set the PULSES PER SEC switch to the speed of the dial, then dial the digit 0 while making the bias adjustment which is described below.

In all the operations described in this paragraph, the % break of the transmitted signal should be measured and, if necessary, readjusted to the desired value before making a test. This function is performed by first adjusting the METER CAL control until the meter reads 0%, then turning the FUNCTION switch to the ADJ % BREAK position after the OPERATION switch has been moved to the desired position. Upon completion of this test, the FUNCTION switch is moved to the SEND & REC position; in this position, the SEND signal is transmitted to the line under test which should be plugged into the appropriate jack.

1. If it is desired to send "open and short" pulses on the ring and tip of the SEND LOOP jacks marked 1 and 2 while simultaneously receiving a battery and ground signal from an external circuit which is connected to the REC LOOP jack, turn the OPERATION switch to the REC B&G, SEND LOOP position. After setting the desired % break of the send signal, turn the FUNCTION switch to the SEND & REC position

2. If it is desired to send "open and short" pulses on the ring and tip of the SEND LOOP jacks marked 1 and 2 while simultaneously receiving "open and short" pulses from an external circuit which is connected to the REC LOOP jack, turn the OPERATION switch to the REC LOOP, SEND LOOP or SL position, and turn the button switch in the lower left corner of the panel to the SEND RT 1 and 2 position.

   After setting the desired % break of the send signal, turn the FUNCTION switch to the SEND & REC position.

3. If it is desired to send "open and short" pulses on the sleeves of the SEND LOOP jacks and REC LOOP jack while simultaneously receiving "open and short" pulses from an external circuit which is connected to the REC LOOP jack, turn the OPERATION switch to the REC LOOP, SEND LOOP or SL position, and turn the button switch in the lower left corner of the panel to the SEND SL, SEND 2 & REC position. After setting the desired % break of the send signal, turn the FUNCTION switch to the SEND & REC position. Sending "open and short" pulses on the SEND LOOP 1 and 2 jacks is also available for the switch positions described above.

4. If it is desired to send toward the line in an E&M circuit, turn the OPERATION switch to the B&G TWD LINE or B&O TWD LINE position, as the case requires, and move the SEND and TEST switch to the TEST L&D position. Next insert a twin cord in the LINE and DROP twin jacks in the TTS 26A and then insert the other end in the jack field. If both lamps are lighted, indicating that the circuit is idle, move the SEND and TEST switch to the DIAL or OSC position as desired. Having set up the desired % break of the SEND signal, turn the FUNCTION switch to the SEND & REC position.

5. If it is desired to send toward the DROP side of an E&M circuit, turn the OPERATION switch to the B&G TWD DROP or B&O TWD DROP position, as the case requires, and move the SEND and TEST switch to the TEST L&D position. Next, insert a twin cord in the LINE and DROP twin jacks in the TTS 26A and then insert the other end in the jack field. If both lamps are lighted, indicating that the circuit is IDLE, move the SEND and TEST switch to the DIAL or OSC position as desired. Having set up the desired % break of the SEND signal, turn the FUNCTION switch to the SEND & REC position.

6. If it is desired to send into the M lead on circuits where the E&M leads are available on separate jacks, set the OPERATION switch to the B&G TWD LINE or B&O TWD LINE position, as the case requires, and connect the M jack of the TTS 26A to the M jack of the equipment. Having set up the desired % break of the send signal, turn the FUNCTION switch to the SEND & REC position.

Talking on the Circuits Under Test

6.05 A telephone set connected to the DIAL or TEL SET terminals or jack is used for all talk functions.

6.06 After a number has been dialed on the loop in accordance with the instructions of section 6.04, place the DIAL and TALK key switch in the TALK LOOP position. It is now possible to hear the ringing of the called number and to talk when the cal l is completed.

6.07 To Talk When Using E&M Operation

1. Patch the tip and ring leads of the talk circuit to the SEND LOOP 1 and 2 jack.

2. After dialing the desired number in accordance with the instructions of section 6.04, place the DIAL and TALK key switch in the TALK E&M position.

3. It is now possible to talk when the the call is completed.

Special Functions

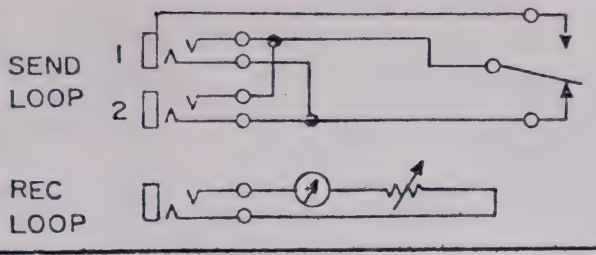
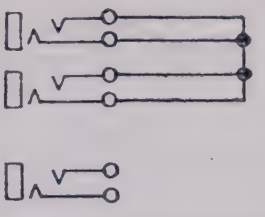
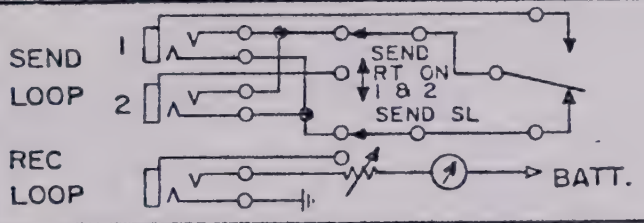
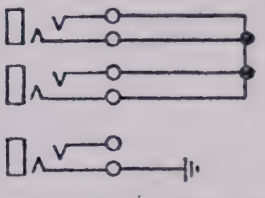
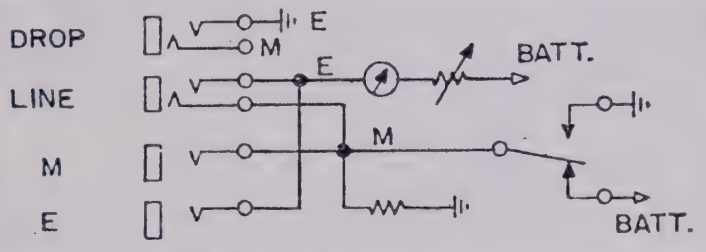
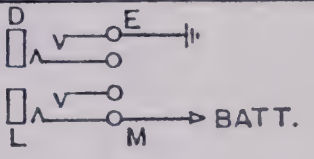
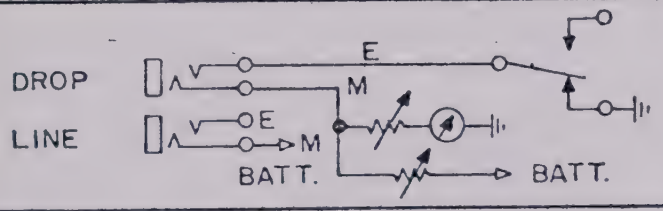
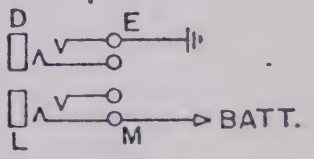
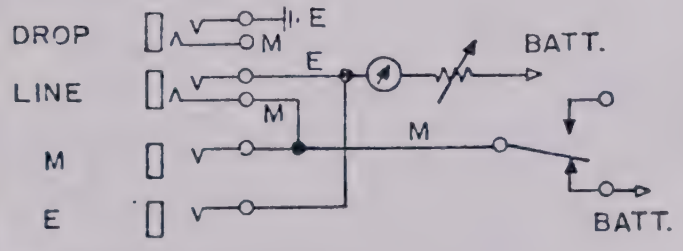
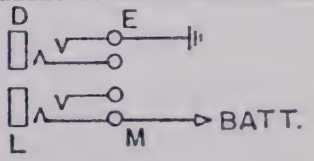
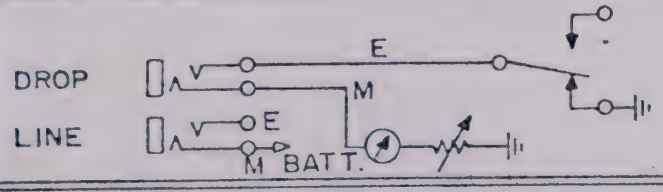
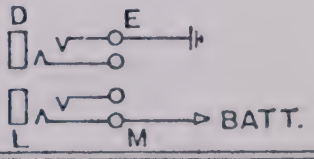
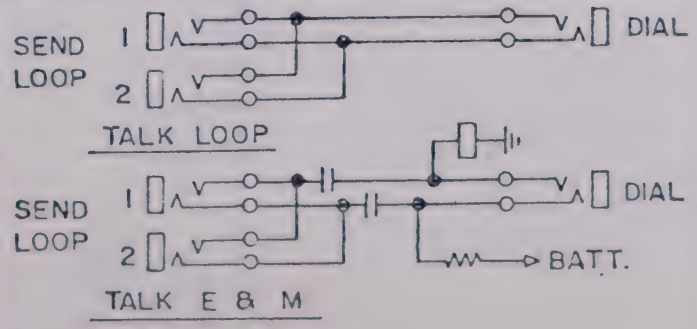
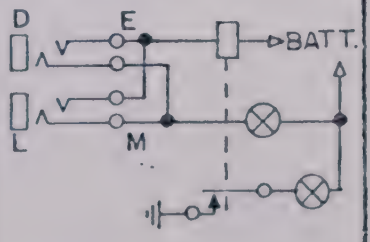
6.08 The SEND and RECEIVE circuits available in the set are diversified enough to permit a variety of send and receive arrangements for loop and E&M operation.

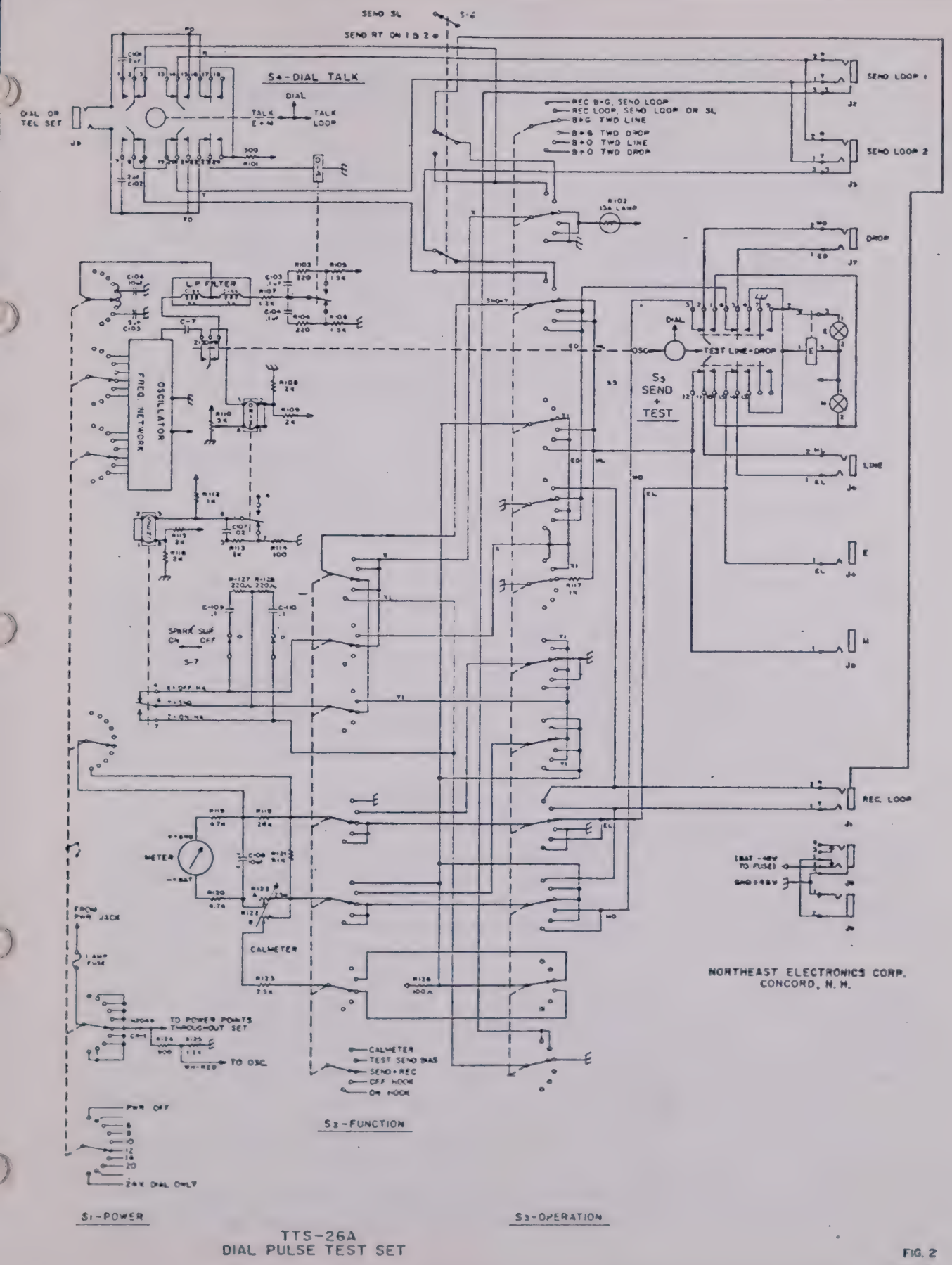
6.09 It is possible to use the TTS 26A to generate special signals. When the OPERATION switch is in either of the first two positions of the FUNCTION switch for sending "open and short" pulses on the ring and tip of the SEND LOOP jacks, the sleeve of the SEND LOOP 1 jack is also connected to a contact on the send relay. The armature of the send relay is thus connected to the tip of the SEND LOOP 1 jack and the pulsed contacts are connected to the ring and sleeve. By means of a 3-conductor cord plugged in the SEND LOOP 1 jack it is possible to use the TTS 26A to generate polar duplex signals, to switch a voice circuit, to key a voice frequency oscillator, etc. The REC LOOP circuits may be used simultaneously with the SEND LOOP function.

6.10 It is possible to provide battery in series with loop pulsing by using a special cord. The cord, with ring-tip connections, would plug into the SEND LOOP jacks. One lead would be split so that the two resulting leads could be connected to battery. This arrangement would be particularly useful for sending loop pulses with battery to an SF converter.

6.11 When a signal with an accurate pulse rate of 10 pps is measured, the % break directly indicates the number of milliseconds "break" of the signal. When the pulse rate of the signal is exactly 20 pps, the % break as measured on the meter

is twice the number of milliseconds break of the signal. In general, the number of milliseconds break equals the % break read on the dial multiplied by 10/fp where fp is the pulses per second of the signal.

OPERATION SW.	FUNCTION SW.: — SEND + REC. POSITION	-ADJ. % BREAK POSITION
REC B&G SEND LOOP		
REC LOOP SEND LOOP OR SL		
B & G TWD LINE		
B & G TWD DROP		
B & O TWD LINE		
B & O TWD DROP		
TALK POSITIONS ON DIAL TALK SWITCH		TEST POSITION ON SEND TEST SWITCH 



TTS-26A
DIAL PULSE TEST SET

FIG. 2
ISSUE 3

APPENDIX

A.0 OSCILLATOR-BUFFER AMPLIFIER CIRCUIT

General

A.01 The oscillator-buffer amplifier circuitry contained within the TTS 26A Pulse Signaling Test Set is normally equipped to operate on any one of the following frequencies: 6, 8, 10, 12, 14, or 20 cps. Additional frequencies can be installed on special order. The oscillator-buffer also provides an output sine wave to operate the DRIVE relay.

A.02 As transistorized circuits are used, no external power other than the 48-volt station battery is required; no warm-up period is required for this unit.

Circuit Description

A.03 The circuit diagram to which the following description applies is shown in Fig. A1.

A.04 A bridged-T type of R-C oscillator, consisting of three transistor stages is used. The first two transistors are directly coupled from the collector of Q1 to the base of Q2. The positive feedback path is completed from the emitter of Q2 back through a blocking capacitor, C2 and a tungsten lamp, R89, utilized for level stabilization, to the emitter of Q1. A part of the emitter resistance, R15, of Q1 has been made variable to allow setting the correct amount of positive feedback necessary for stable operation.

A.05 A negative feedback which is greater than the positive feedback is supplied to the base of Q1 through a null selective network and an emitter follower, Q3. At its tuned frequency the selective bridged-T null network decreases the negative feedback sufficiently to permit oscillation to occur at the desired frequency, which is determined by the R-C values employed within the network. This frequency determining network consists of two capacitors, C4 and C5, and two selected value resistors.

A.06 Amplifier stage Q4 and the cascade emitter follower stages, Q5 and Q6, provide the necessary voltage and current gain required to operate the DRIVE relay. The output level of the amplifier stage is determined by the setting of potentiometer R19. Capacitor C7 provides DC blocking between the output emitter follower Q6 and the driven coil of the DRIVE relay.

Maintenance and Trouble-Shooting

A.07 Apart from the normal periodic cleaning of the jack contacts, the TTS 26A does not require any routine maintenance.

A. 08 If any abnormal operation occurs, it can easily be traced to one of four groups of circuits. These circuits are as follows:

1. Oscillator circuit
2. Buffer-amplifier circuit
3. Drive relay, send relay, and associated bias circuitry
4. External dial and telset circuits

The general location of the major component parts of the TTS 26A is shown in Figs. A2, A3, and A4.

A. 09 When the DRIVE relay fails to operate, the trouble is most likely to be traced to one of two causes:

1. Station battery polarity reversed
2. Oscillator-buffer amplifier circuitry inoperative

A. 10 After the battery polarity has been checked, position the ADJ % BREAK control to its mid-position and conduct trouble shooting of the oscillator-buffer amplifier circuitry as follows.

A. 11 Referring to Fig. A1, connect the high side of a VTVM to point A and the low side to the ground terminal as indicated on the printed circuit board assembly, Fig. A2. The voltage should be 1. 5 volts RMS at this point. If not, adjust R15 for this level. Turning R15 in a clockwise direction increases the positive feedback and therefore increases the output level appearing at Point A. There should be no fluctuation of the signal level at this point once the level has been adjusted to 1. 5 volts RMS.

A. 12 If there is no voltage between point A and ground (with R15 in maximum clockwise position), check the filament of the tungsten lamp, R89, for continuity. Replace the lamp if faulty. If the lamp is good, substitute transistors, starting with Q1 and ending with Q3. If trouble still prevails, check for proper DC voltages as indicated on the schematic diagram of the circuit. These voltages should be within $\pm 10\%$ as indicated. An open condition of filter capacitor C9 can cause faulty operation and should be checked through substitution.

A. 13 Should the preceding steps fail to produce an output of the oscillator at point A, check other components contained within the oscillator circuit such as resistors, capacitors, and the pulse frequency switching network. It is important after correction of the trouble to readjust R15 to produce a voltage indication at point A of 1. 5 volts RMS.

A. 14 With the oscillator operating properly, check the RMS voltage appearing at pin 2 of the DRIVE relay. This voltage should be in the order of 5. 0 volts RMS. The exact voltage depends on the setting of the gain control, R19. If normal signal voltage is not realized at this point, check the buffer amplifier portion of the associated circuitry. After this circuit has been restored to a normal operating con-

dition, adjust the gain control of R19 to provide the desired operating bias range. To decrease the bias range turn R19 in a counter-clockwise direction, and to increase the bias range, turn R19 in a clockwise direction.

A. 15 If a normal driving voltage appears at pin 2 of the DRIVE relay and trouble still prevails, the trouble will be found in either the DRIVE relay, the SEND relay, or their bias networks. When the SEND BIAS control is in its mid-position, the DC voltage between pins 1 and 8 of the DRIVE relay should be very close to 0.

A. 16 Should trouble be traced to either the DRIVE or SEND relay, it is recommended that these relays be removed and tested with proper test equipment such as the Sigma 4500 Series Test Set or equivalent. Should these relays require readjustment, it is recommended that it be done by qualified personnel familiar with the adjustment of this type of polar relays. Standard repair kits containing two contact screws and one Ferro-nickel armature are availabl e.

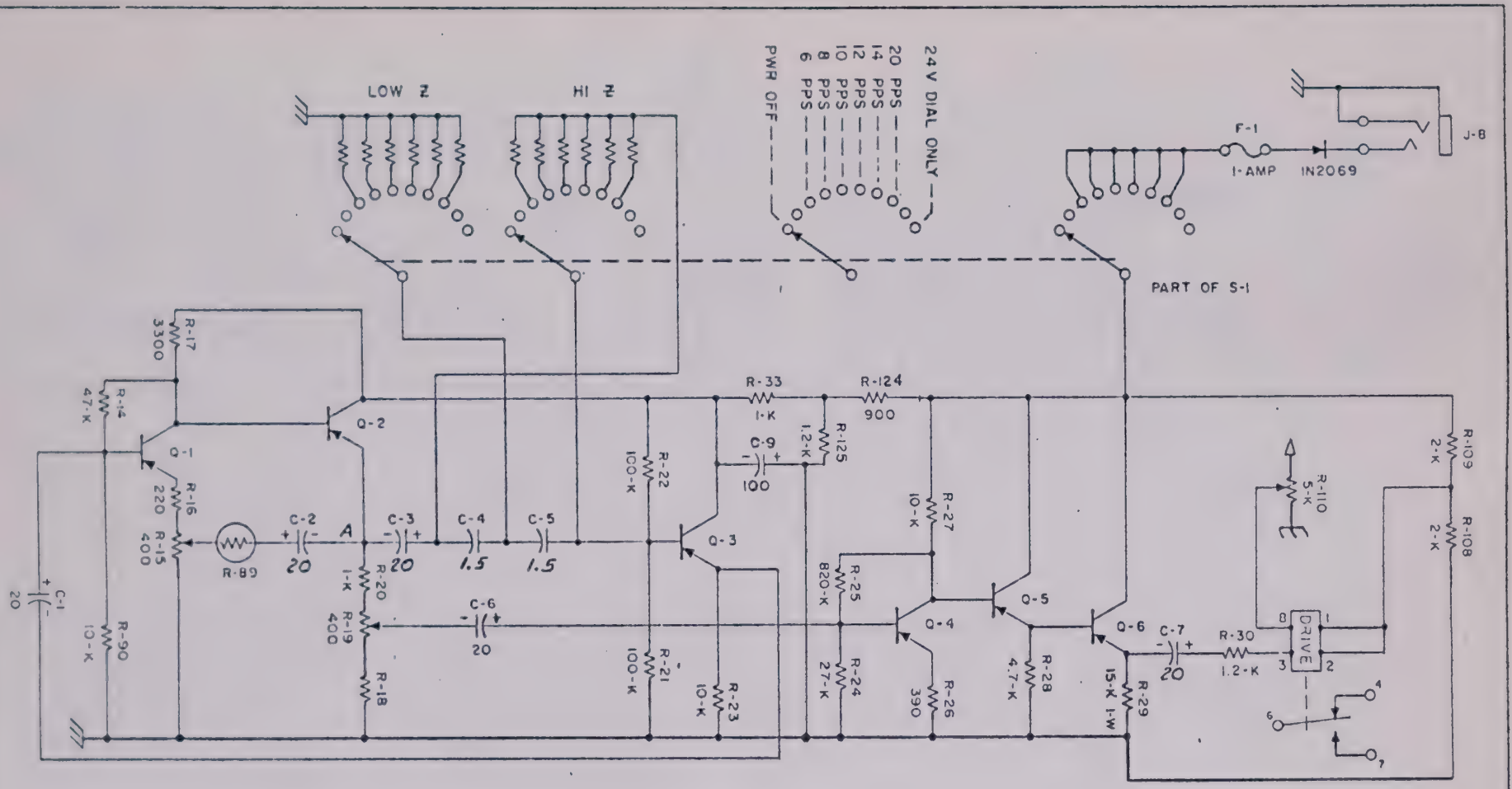
External Dial and Tel Set Circuits

A. 17 Should the external dial fail to produce pulses with switches S4 and S5 in their DIAL positions and the ADJ % BREAK in its mid-position, proceed as follows:

A. 18 Visual inspection of the dial relay will determine whether or not this relay is following the pulses as dialed. If not, refer to Fig. 2 and proceed as follows: Examine the external dial mechanism and the circuitry through to the coil of the dial relay which consists of resistor R101 and the associated contacts on switch S4. If satisfactory operation of the dial relay has been observed, then trouble shooting should be centered around the low pass filter and its associated circuitry. For the location of components within this circuitry, refer to Figs. A3 and A4. While dialing, battery and ground should alternately appear on the armature of the DRIVE relay. If not, inspect resistors R105 and R106. Battery and ground should also appear alternately on the filter side of R127 at the junction of L1 and L2 and again at terminal 16 of S5. If capacitor C105 or C106 is suspected of being defective, these can more easily be checked through substitution. The total DC resistance reading between the armature of the dial relay and the filter output as measured at terminal 16 of S5 should be in the order of 1700 ohms. If not, locate and replace defective component. Contacts 16 and 17 of S5 should also be inspected and cleaned if necessary. The output waveform of this filter should resemble a sine wave; however, some distortion will be visable and is normal. For dial pulse frequencies of 6, 8, 10, 12, and 14 cps, capacitor C106 is switched into the filter circuitry and capacitor C105 is switched into the pulse frequency when dial speeds of 20 cps are needed. The switching is done over deck 5 of Switch S1.

Talk Circuits

A. 19 Should the talk circuitry fail in the talk loop position, contacts 14 and 15 and 20 and 21 of switch S4 should be inspected and cleaned if necessary. Should the talk circuitry in the TALK E&M position fail, then contacts 1 and 2, 13 and 14, 16 and 17, 7 and 8, 19 and 20, and 22 and 23 should be inspected and cleaned if necessary. Battery is supplied to the talk circuit in the E&M position through resistor R101, the associated switch contacts of S4 through the carbon microphone in the external tel set and the coil of the dial relay to ground. Audio signals are taken from this talk circuit through DC blocking capacitors C101 and C102. Inspection of these components and cleaning of the associated switch contacts (including the inspection of the external carbon microphone) should restore this circuitry to normal.

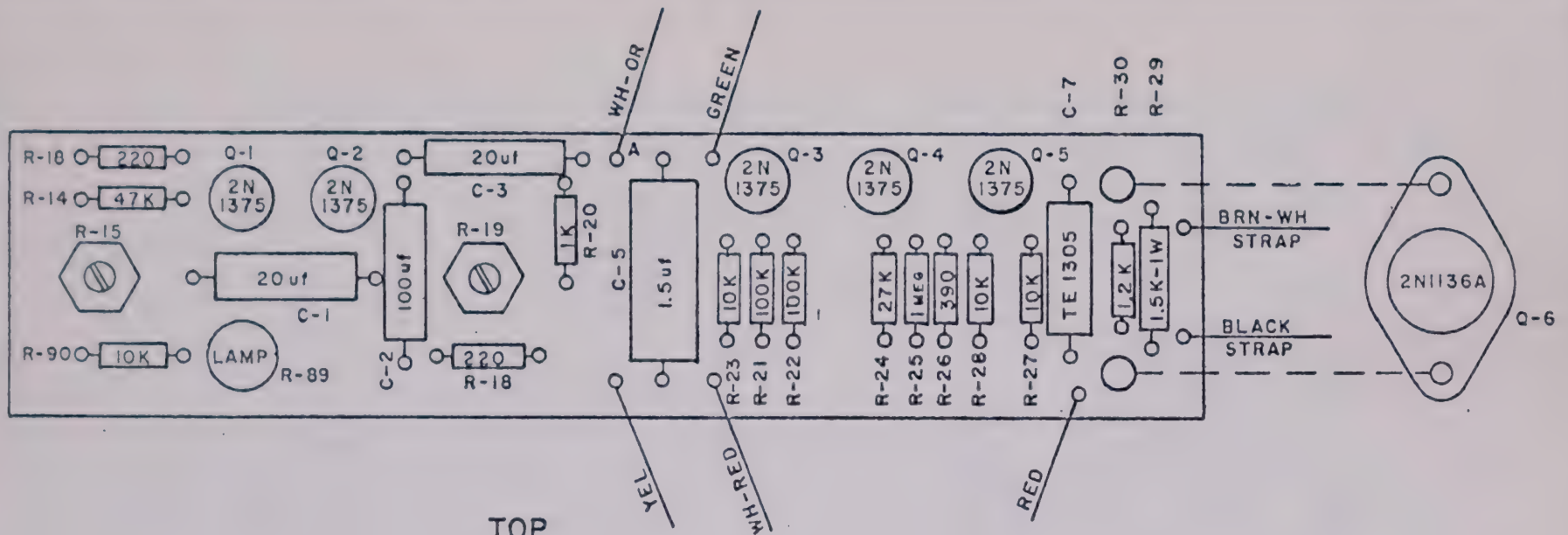


NOTE: Q-1 THRU Q-5 2N1375, Q-6 IN1136A.

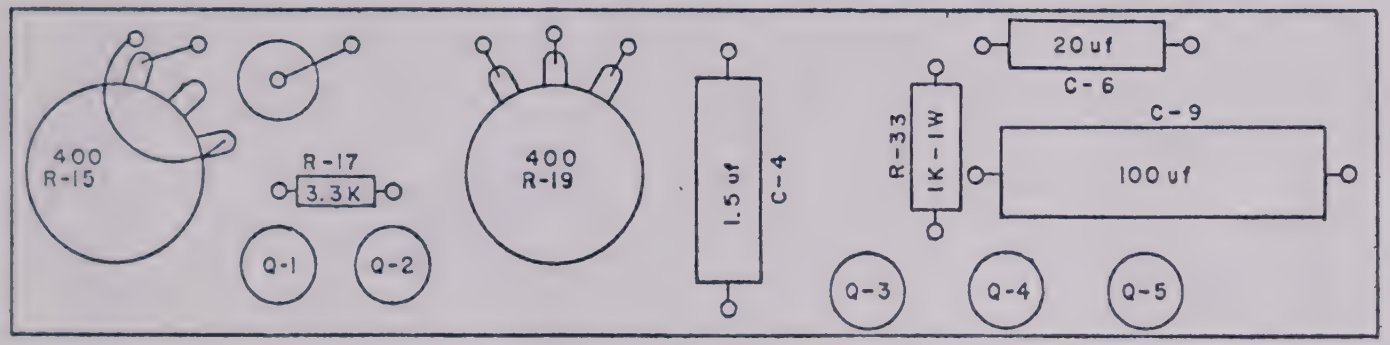
MODEL TTS-26A
PULSE GENERATOR - BIAS CIRCUIT

NORTHEAST ELECTRONICS CORP.
CONCORD, N.H.

FIG. A1



TOP

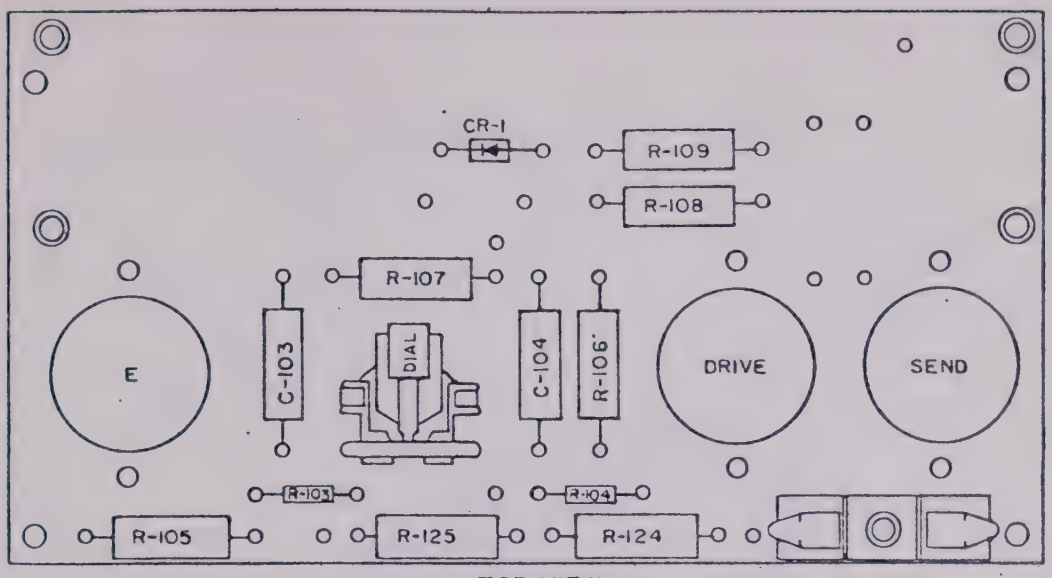


BOTTOM

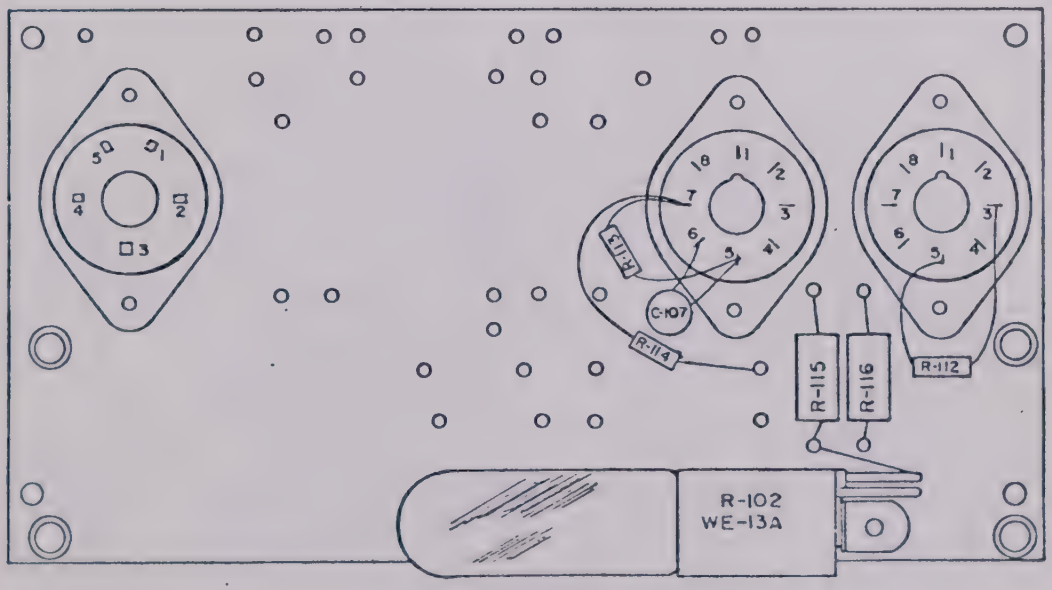
NORTHEAST ELECTRONICS CORP.
CONCORD, N. H.

PRINTED CIRCUIT BOARD
ASSEMBLY
TTS-26A

FIG. A2



TOP VIEW

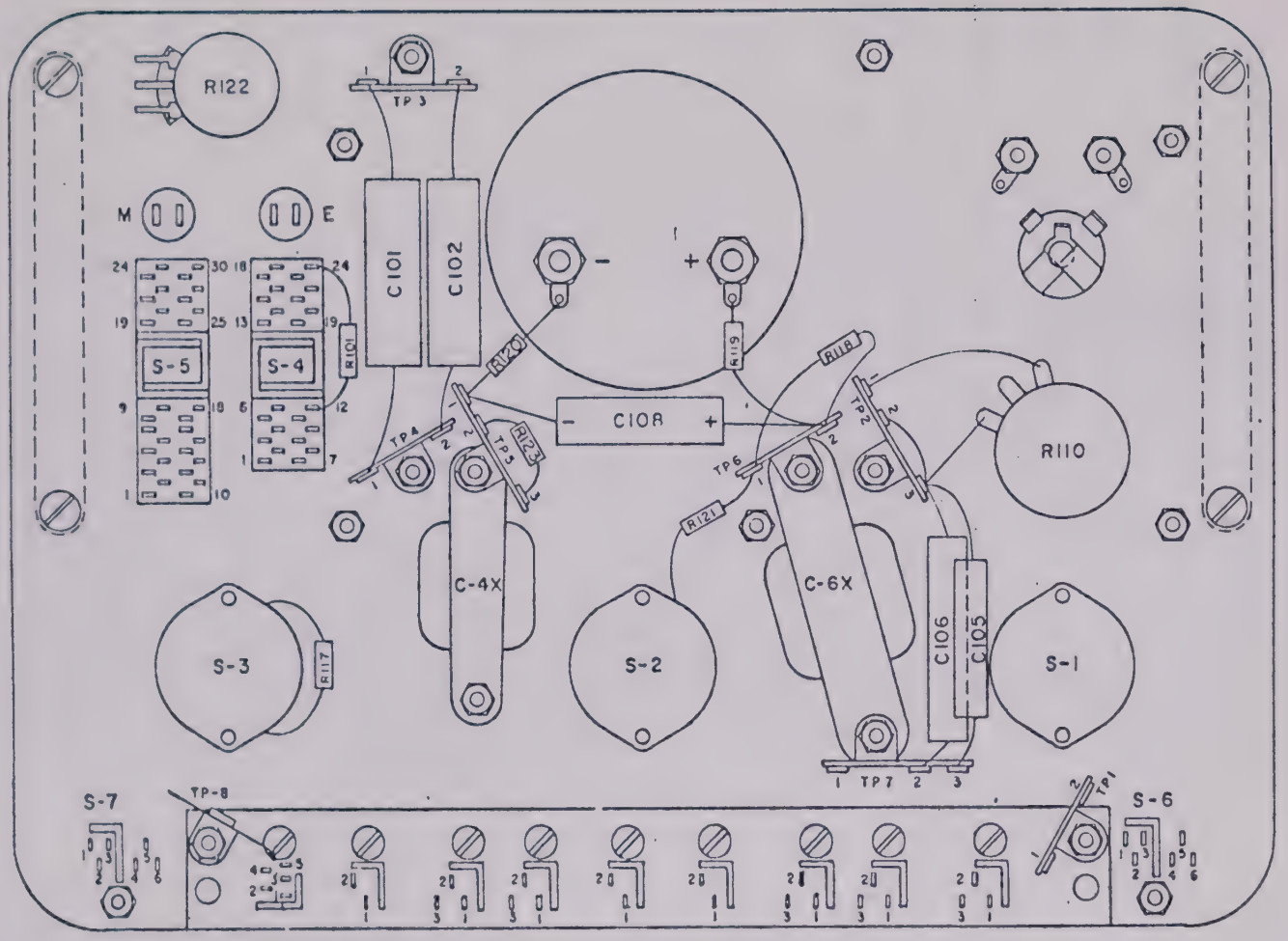


REAR VIEW

MODEL TTS-26A
COMPONENT BOARD
LAYOUT

NORTHEAST ELECTRONICS CORP.
CONCORD, N.H.

FIG. A3



PANEL ASSEMBLY

NORTHEAST ELECTRONICS CORP.
CONCORD, N. H.

FIG. A4

MODEL TTS 26A PULSE SIGNALING TEST SET
TABLE OF REPLACEABLE PARTS

Circuit Ref.	Description	Mfr* & Mfr's Designation
C101	Capacitor: fixed, paper, 2 mfd, 150 vdc	O, 121P20591R5S4
C102	Capacitor: fixed, paper, 2 mfd, 150 vdc	O, 121P20591R5S4
C103	Capacitor: fixed, ceramic, 0.1 mfd, 75 vdc	E, DDA-104
C104	Capacitor: fixed, ceramic, 0.1 mfd, 75 vdc	E, DDA-104
C105	Capacitor: fixed, electrolytic, 5 mfd, 50 vdc	O, TVA-1303
C106	Capacitor: fixed, electrolytic, 10 mfd, 50 vdc	O, TVA-1304
C1-7	Capacitor: fixed, ceramic, 0.02 mfd	E, ID-02
C1-8	Capacitor: fixed, electrolytic, 10 mfd, 50 vdc	O, TVA-1303
C109	Capacitor: fixed, ceramic, 0.1 mfd, 75 vdc	E, DDA-104
C110	Capacitor: fixed, ceramic, 0.1 mfd, 75 vdc	E, DDA-104
R101	Resistor: fixed, composition, 300 ohm ±10%, 3 w	J, PW-3
R102	Resistor: resistance lamp	R, 13A
R103	Resistor: fixed, composition, 220 ohm ±10%, ½ w	B
R104	Resistor: fixed, composition, 220 ohm ±10%, ½ w	B
R105	Resistor: fixed, composition, 1.5 K ±10%, 3 w	J, PW-3
R106	Resistor: fixed, composition, 1.5 K ±10%, 3 w	J, PW-3
R107	Resistor: fixed, composition, 1.2 K ±10%, 3 w	J, PW-3
R108	Resistor: fixed, composition, 2 K ±10%, 3 w	J, PW-3
R109	Resistor: fixed, composition, 2K ±10%, 3 w	J, PW-3
R110	Resistor: variable, wirewound, 5 K 5 w	F, CM30154NP
R112	Resistor: fixed, composition, 1 K ±10%, 3 w	J, PW-3
R113	Resistor: fixed, composition, 1 K ±10%, 3 w	J, PW-3

Circuit Ref.		Description	Mfr* & Mfr's Designation
R114	Resistor:	fixed, composition, 100 ohm ±10%, 3 w	J, PW-3
R115	Resistor:	fixed, composition, 2 K ±10%, 3 w	J, PW-3
R116	Resistor:	fixed, composition, 2 K ±10%, 3 w	J, PW-3
R117	Resistor:	fixed, composition, 1 K ±10%, 3 w	J, PW-3
R118	Resistor:	fixed, composition, 24 K ±10%, ½ w	B
R119	Resistor:	fixed, composition, 4.7 K ±10%, ½ w	B
R120	Resistor:	fixed, composition, 4.7 K ± 10% ½ w	B
R121	Resistor:	fixed, composition, 9.1 K ±10%, ½ w	B
R122A R122B	Resistor:	variable, dual, wirewound, 25 K, 500 ohm	F, CM30312NP
R123	Resistor:	fixed, composition, 7.5K, ±10%, ½ w	B
R124	Resistor:	fixed, composition, 900 ohm ±10%, 3 w	J, PW-3
R125	Resistor:	fixed, composition, 1200 ohm ±10%, 3 w	J, PW-3
R126	Resistor:	fixed, composition, 100 ohm ±10%, 3 w	J, PW-3
J1	Jack:	telephone	P, 5J-1329
J2	Jack:	telephone	P, 5J-1329
J3	Jack:	telephone	P, 5J-1329
J4	Jack:	telephone	P, 5J-1194MT
J5	Jack:	telephone	P, 5J-1194MT
J6	Jack:	telephone	P, 5J-1329
J7	Jack:	telephone	P, 5J-1329
J8	Jack:	telephone	P, 5J-1192

Circuit Ref.	Description		Mfr* & Mfr's Designation
J9	Jack:	telephone	P, L12B
J10	Jack:	telephone	P, 5J-1194MT
S1	Switch:	rotary, 10 position, 7 pole (POWER)	E, PA-022-2704
S2	Switch:	rotary, 5 position, 5 pole (FUNCTION)	E, PA-1021
S3	Switch:	rotary, 6 position, 11 pole (OPERATION)	E, PA-2037
S4	Switch:	key, telephone, 3 position (DIAL-TALK)	P, 173-P
S5	Switch:	key, telephone, 3 position (SEND-TEST)	P, 173-D
S6	Switch:	turnbutton, 2 position, (SEND SL-SEND RT ON 1 & 2)	P, 9S-1097
S7	Switch:	turnbutton, 2 position (SPARK SUP)	P, 11206-L
	Relay:	SPDT	M, 1200LG-SIL or equivalent
	Relay:	SPDT, polar	M, 72AOZ-1000SIL or equivalent
	Relay:	SPDT, polar	M, 72AOZ-1000SIL or equivalent
CR-1	Diode:	silicon	R, 1N2069
Q1	Transistor:		S, 2N1375
Q2	Transistor		S, 2N1375
Q3	Transistor		S, 2N1375
Q4	Transistor		S, 2N1375
Q5	Transistor		S, 2N1375
Q6	Transistor:	power	D, 2N1136A
T1	Inductor:	4 henry	T, C4X
T2	Inductor:	6 henry	T, C6X
	Meter:	special	NEC, #124
	Lamp:	drop, pilot lamp assembly	G, 105-4428-722

Circuit Ref.	Description		Mfr* & Mfr's Designation
	Lamp:	line, pilot lamp assembly	G, 105-4428-722
	Fuse Holder		L, 357001
	Printed Circuit Board		NEC, 26A
	Socket:	5 pin, (1 per set)	C, 77-M1-P5
	Socket:	8 pin (2 per set)	C, 77-M1-P8
	Knobs:	(3 per set)	K, 648-3L-BB
	Knobs:	(2 per set)	K, 645-3-BB
	Fuse:	1 ampere	L, 3AG-1A

The following parts are contained on the Model TTS 26A printed circuit board.

C1	Capacitor:	fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C2	Capacitor:	fixed, electrolytic, 100 mfd, 20 vdc	I, APD-095
C3	Capacitor:	fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C4	Capacitor:	fixed, paper, 1.5 mfd, 50 vdc	A, P1232N
C5	Capacitor:	fixed, paper, 1.5 mfd, 50 vdc	A, P1232N
C6	Capacitor:	fixed, electrolytic, 20 mfd, 25 vdc	I, APD-046
C7	Capacitor:	fixed, electrolytic, 20 mfd, 50 vdc	O, TE1305
C8	Capacitor:	fixed, electrolytic, 100 mfd, 50 vdc	I, APD-127
R14	Resistor:	fixed, composition, 47 K $\pm$10%, $\frac{1}{2}$ w	B
R15	Resistor:	variable, wirewound, 400 ohms	F, CM22425
R16	Resistor:	fixed, composition, 220 ohms $\pm$10%, $\frac{1}{2}$ w	B
R17	Resistor:	fixed, composition, 3.3 K $\pm$10%, $\frac{1}{2}$ w	B
R18	Resistor:	fixed, composition, 220 ohms $\pm$10%, $\frac{1}{2}$ w	B
R19	Resistor:	variable, wirewound, 400 ohms	F, CM22425

Circuit REF		Description	Mfr* & Mfr's Designation
R20	Resistor:	fixed, composition, 1.0 K ±10%, ½ w	B
R21	Resistor:	fixed, composition, 100 K ±10%, ½ w	B
R22	Resistor:	fixed, composition, 100 K ±10%, ½ w	B
R23	Resistor:	fixed, composition, 10 K ±10%, ½ w	B
R24	Resistor:	fixed, composition, 27 K ±10%, ½ w	B
R25	Resistor:	fixed, composition, 1 meg ±10%, ½ w	B
R26	Resistor:	fixed, composition, 390 ohms ±10%, ½ w	B
R27	Resistor:	fixed, composition, 10K ±10%, ½ w	B
R28	Resistor:	fixed, composition, 10 K ±10%, ½ w	B
R29	Resistor:	fixed, composition, 1.5 K ±10%, 1 w	B
R30	Resistor:	fixed, composition, 1.2 K ±10%, ½ w	B
R33	Resistor:	fixed, composition, 1.0 K ±10% ½ w	B
R89	Lamp:	tungsten (used as resistor), 4 w, 120 vdc	H, T 4½
R90	Resistor:	fixed, composition, 10 K ±10%, ½ w	B

*See List of Manufacturers Code Letters for Replaceable Parts Table on next page.

LIST OF MANUFACTURERS CODE LETTERS FOR REPLACEABLE PARTS TABLE

Code Letter	Manufacturer
A	Aerovox Corporation
B	Allen-Bradley Company
C	Amphenol Manufacturing Company
D	Bendix Corporation
E	Centralab
F	Clarostat Manufacturing Company, Inc.
G	Dialight Corporation
H	Herzog Miniature Lamp Works, Inc.
I	International Electronics Industries, Inc.
J	International Resistance Company
K	Kurz-Kasch, Inc.
L	Littlefuse, Inc.
M	Sigma Instruments, Inc.
NEC	Northeast Electronics Corporation
O	Sprague Electric Company
P	Switchcraft, Inc.
R	Sylvania Electric Company
S	Texas Instruments, Inc.
T	Triad Transformer Corporation